**No. 595** **13 July 2007**

## SOUTH AFRICAN QUALIFICATIONS AUTHORITY (SAQA)

In accordance with Regulation 24(c) of the National Standards Bodies Regulations of 28 March 1998, the Standards Generating Body (SGB) for

**Generic Manufacturing, Engineering and Technology**

registered by Organising Field 06 – Manufacturing, Engineering and Technology, publishes the following Qualification and Unit Standard for public comment.

This notice contains the titles, fields, sub-fields, NQF levels, credits, and purpose of the Qualification and Unit Standard. The full Qualification and Unit Standard can be accessed via the SAQA web-site at **www.saqa.org.za**. Copies may also be obtained from the Directorate of Standards Setting and Development at the SAQA offices, SAQA House, 1067 Arcadia Street, Hatfield, Pretoria.

Comment on the Qualification and Unit Standard should reach SAQA at the address below and ***no later than 13 August 2007.*** All correspondence should be marked **Standards Setting – Generic Manufacturing, Engineering and Technology** and addressed to

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SOUTH AFRICAN QUALIFICATIONS AUTHORITY

***QUALIFICATION:***
***Further Education and Training Certificate: Engineering Fabrication***

| *SAQA QUAL ID* | *QUALIFICATION TITLE* | | |
|---|---|---|---|
| 58721 | Further Education and Training Certificate: Engineering Fabrication | | |
| *ORIGINATOR* | | *PROVIDER* | |
| SGB Generic Manufacturing, Engineering & Technolog | | | |
| *QUALIFICATION TYPE* | *FIELD* | *SUBFIELD* | |
| Further Ed and Training Cert | 6 - Manufacturing, Engineering and Technology | Fabrication and Extraction | |
| *ABET BAND* | *MINIMUM CREDITS* | *NQF LEVEL* | *QUAL CLASS* |
| Undefined | 141 | Level 4 | Regular-Unit Stds Based |

***PURPOSE OF THE QUALIFICATION***
Purpose:

This qualification is designed to meet the needs of the Learner in a variety of engineering related sectors. Engineering Fabrication is a generic engineering and trade related qualification that builds on the competencies of fabrication. This qualification will provide learners, education and training providers and employers with the standards and the range of learning required to work effectively in various industries making use of complex engineering fabrication processes and methods.

The main skill that is recognised in this qualification is the ability to produce complex components of using a variety of fabrication methods. This capability requires an understanding of, and the ability to, lay out and mark off complex shapes; set up and use powered machinery; develop and fabricate from complex drawings and sketches and cut and join components using welding and other mechanical methods.

The metal components that the qualified person fabricates will be vital for the construction, maintenance and reliable operation of equipment and machinery in a variety of industries.

The qualification adds value to the qualifying learner in terms of enrichment of the person, recognition, and contributes towards the achievement of competencies that allows the qualifying learner to display the ability to lead, and communicate with, people to ensure the relevant work is performed in an acceptable manner. This will include basic concepts of coaching, assessment and functional business concepts.

The qualification is structured in such a way that it exposes learners to generic and specific competencies, of a specialist nature, as required in Engineering Fabrication industries. This qualification makes provision for engineering fabrication to be applied within the following sectors:

- Mining and Minerals sector.
- Chemical sector.
- Transport sector.
- Manufacturing sector.
- Other engineering related sectors.

Qualifying learners will be able to:

- Demonstrate an understanding of a variety of complex engineering fabrication methods.
- Demonstrate the ability to use equipment to cut, drill and punch, assemble and mechanically join structural metal work.
- Maintain and support procedures to solve a variety of problems, both familiar and unfamiliar, within an engineering fabrication context, and operate within familiar and new situations, taking responsibility and making decisions.
- Demonstrate leadership through effective interaction and communication with peers and members of supervisory and management levels by co-ordinating a working team, promoting the maintenance of a safe and efficient workplace, and developing the skills and performance of workgroup members, whilst meeting output requirements and working safely with due care for fellow workers and the environment.

Qualifying learners will also understand:

- The basics of how a business functions, and the role of the qualified learner in the business, i.e. fabrication and related activities.
- How the learning achieved whilst obtaining this qualification relates to the learning required in other similar qualifications.
- The importance of communication in achieving goals.
- How they are affected by legislation, regulations, agreements and policies related to their particular work environment.

With this understanding, learners will be able to participate effectively in workplace activities.

Rationale:

Engineering Fabrication, in the context of this qualification is the designing and fabrication of complex metal components. These components are usually required for initial or replacement purposes, as opposed to merely for maintenance reasons, as required within various industry sectors. The main focus is on interpreting complex drawings, the lay out and development of complex metal components, and manipulation of metal (sheet metal, plate and pipe) to produce usable components, as per design requirements.

This qualification is for learners who wish to further their learning and to possibly specialise in fabrication, within the context of boiler making, plating, welding, sheet metal working or auto vehicle body building. This qualification also lends itself to the development of the learner to progress to levels Of supervision and is suitable for application in various industries, such as the Mining and Minerals Industry; Chemical; Petro-chemical; Metal, Engineering and related industries.

It enables learners who have gained relevant experience in the workplace to gain credits through the RPL process. The qualification also forms the basis for further learning in the field of engineering fabrication where the learner will be able to specialise in one of the Fabrication or Welding skills areas at NQF Level 5.

Most industries rely on the design and fabrication of complex metal components. Examples of this may be the chemical industry where a wide variety of pipes of various shapes and sizes are utilised. Invariably these pipes are exclusive to a particular plant and need to be specifically fabricated to be fit for purpose. The mining and minerals industry typically has a need for designing and fabrication of components that require special welding and fabrication processes to cater for moving of men and materials. It is evident that each peculiar industry will have specific specialist requirements.

The design of this qualification stems from the collaborative approach to achieve generic type qualifications that allows progression and access, within and between sectors. Certain components of learning within this qualification may have pertinence within other engineering learning fields. This will predominantly be in the area of interpreting complex drawings, welding and the lay out and development of complex metal components.

The qualifying learner will be more employable within a broad industry context, and will thus be a contributing factor to the economy of the relevant organisation and the country. The learner will benefit from obtaining this qualification due to the fact that industry has a need for persons with the ability to design, develop and fabricate complex industry related equipment.

This qualification focuses on developing skills and knowledge necessary to perform at the level of competence required. This qualification replaces the (currently de-registered) Further Education Certificate: Fabrication Level 4 and the interim registered National Certificate: Plater Welder and Plater Boilermaker NQF Level 3.

As this qualification forms the basis for further learning in the field of engineering fabrication, where the learner will be able to specialise in one of the Fabrication or Welding skills areas, it is accepted that the learner may exit (and be employed at this level (NQF Level 4)), or continue further learning toward obtaining the next level qualification.

The learner may also choose to learn towards achievement in other fields, as the learning in the fundamental and core component of this qualification lends itself to lateral as well as vertical exploitation. This qualification enables learners who have gained relevant experience in the workplace to gain credits through the RPL process.

***RECOGNIZE PREVIOUS LEARNING?***
Y

***LEARNING ASSUMED IN PLACE***
In order that the learner may progress at a desired rate whilst learning towards this qualification, it is assumed that learners are already competent in Communication and Mathematics at NQF Level 3.

Recognition of Prior Learning:

This qualification can be achieved wholly or in part through recognition of prior learning in terms of the criteria laid out above.

Evidence can be presented in a variety of forms, including international or previous local qualifications, reports, testimonials mentioning functions performed, work records, portfolios, videos of practice and performance records.

Access to the Qualification:

Access to this qualification is open. However, it is preferable that learners have completed a relevant industry related National Certificate at NQF Level 3. An example of this may be the National Certificate: Engineering Fabrication NQF Level 3.

***QUALIFICATION RULES***
To achieve this qualification the learner must achieve a minimum of 141 Credits.

The learner must achieve the Fundamental, Core and Elective learning components of this qualification as follows:

Fundamental Unit Standards:

• Learners wishing to achieve this qualification must successfully complete all the listed fundamental unit standards with a total credit value of 56 credits.

Core Unit Standards:

• Learners wishing to achieve this qualification must successfully complete all the listed core unit standards with a total credit value of 70 credits.

Elective Unit Standards:

• Learners wishing to achieve this qualification must successfully obtain a minimum of 15 credits from the list of elective unit standards.

***EXIT LEVEL OUTCOMES***

1. Demonstrate the ability to produce complex components using a variety of fabrication methods and operations.

2. Maintain and support procedures to solve a variety of problems, both familiar and unfamiliar, within an engineering fabrication context, and operate within familiar and new situations, taking responsibility and making decisions.

3. Demonstrate the ability to use equipment to cut, drill and punch, assemble and mechanically join structural metal work.
• Range: Equipment includes power tools; hand tools and fixed machinery.

4. Demonstrate leadership through effective interaction and communication with peers and members of supervisory and management levels by co-ordinating a working team, promoting the maintenance of a safe and efficient workplace, and developing the skills and performance of workgroup members, whilst meeting output requirements and working safely with due care for fellow workers and the environment.

Critical Cross-Field Outcomes:

In accordance with SAQA guidelines, all unit standards include the assessment of relevant critical cross-field outcomes. Consequently, Exit Level Outcomes are consistent with critical cross-field outcome requirements.

The following CCFO's have been addressed in this qualification as per the unit standards outlined in the Annexures.

Identifying and solving problems in which responses display that responsible decisions using critical thinking have been made.
• Evident in Exit Level Outcome/s 1, 2, 3, 4.

Working effectively with others as a member of a team, group, organisation and community.
• Evident in Exit Level Outcome/s 2, 4.

Organising and managing oneself and one's activities responsibly and effectively.
• Evident in Exit Level Outcome/s 1, 2, 3, 4.

Collecting, analysing, organising and critically evaluating information.
• Evident in Exit Level Outcome/s 1, 2, 3, 4.

Communicating effectively using visual, mathematical and/or language skills.
• Evident in Exit Level Outcome/s 1, 2, 3, 4.

Using science and technology effectively and critically, showing responsibility toward the environment and health of others.
• Evident in Exit Level Outcome/s 1, 2, 3.

Demonstrating an understanding of the world as a set of related systems by recognising that problem contexts do not exist in isolation.
• Evident in Exit Level Outcomes 1, 3, 4.

Contributing to the full personal development of each learner and the social and economic development of society at large, by making it an underlying intention of the programme of learning to make an individual aware of:

• Reflecting on and exploring a variety of strategies to learn more effectively.
• Participating as responsible citizens in the life of local, national and global communities.
• Being culturally and aesthetically sensitive across a range of contexts.
• Exploring education and career opportunities.
• Developing entrepreneurial opportunities.
(Evident in all Exit Level Outcomes).

***ASSOCIATED ASSESSMENT CRITERIA***
Associated Assessment Criteria for Exit Level Outcome 1:

• The interpretation of complex instructions/drawings to producing complex plating and structural metal drawings is demonstrated and applied in accordance with performance standards.
• Measuring and marking off of detailed plating and structural metal for complex component manufacture is demonstrated according to specified requirements.
• Complex components are produced according to specified requirements.
• Occupational health, safety and environmental legislation is understood in order to apply specific safety practices and procedures relevant to the engineering fabrication industry.

Associated Assessment Criteria for Exit Level Outcome 2:

• Appropriate problem solving techniques are applied to ensure familiar and new problems are addressed within the workplace.
• Decisions are made in accordance with work and organisational requirements.
• The ability to successfully produce complex components within a variety of situations is demonstrated in accordance with performance standards.

Associated Assessment Criteria for Exit Level Outcome 3:

• Appropriate machinery is used to form structural metal work in accordance with specified drawing requirements.
• Appropriate equipment is utilised in a manner that facilitates cutting, drilling and punching of structural metal work according to drawing specifications.
• Structural metal work is assembled using appropriate techniques; powered tools and equipment according to drawing specifications.

Associated Assessment Criteria for Exit Level Outcome 4:

• The work team is coordinated in a manner that promotes team work and avoids conflict. The team also displays an ability to work in a safe and efficient way accordance with site specific practices and policies.

- Current skills and performance of the work team is monitored and the necessary interventions (coaching/leading) are implemented when required.
- Work team output is monitored and maintained in order to identify problems and determine trends.
- Correct technical information is communicated using written reports.

Integrated Assessment:

Integrated assessment at the level of the qualification provides an opportunity for learners to show they are able to integrate concepts, actions and ideas achieved across a range of unit standards and contexts.

Integrated assessment must evaluate the quality of observable performance as well as the thinking behind the performance, and must be based on a summative assessment guide. The guide will spell out how the assessor will assess different aspects of the performance and will include:

- Observing the learner at work (both in the primary activity as well as other interactions).
- Asking questions and initiating short discussions to test understanding.
- Looking at records and reports in the portfolio and reviewing previous assessments.

In some cases inference will be necessary to determine competence depending on the nature and context within which performance takes place.

It is necessary to ensure that the fundamental part of the qualification is also targeted to ensure that while the competence may have been achieved in a particular context, learners are able to apply it in a range of other contexts and for further learning. The assessment should also ensure that all the critical cross-field outcomes have been achieved.

The learner may choose in which language s/he wants to be assessed. This should be established as part of a process of preparing the learner for assessment and familiarising the learner with the approach being taken.

While this is primarily a workplace-based qualification, evidence from other areas of endeavour may be introduced if pertinent to any of the exit-level outcomes. The assessment process should cover both the explicit tasks required for the qualification as well as the understanding of the concepts and principles that underpin the activities associated with the engineering fabrication process.

***INTERNATIONAL COMPARABILITY***

It must be stated from the outset of this statement that reference to international benchmarking for this qualification series, applies only to the education and training content at specific levels between NQF Level 3 and NQF Level 4 and its measure of "appropriateness" when compared with fabrication training programs internationally. It was not possible to assimilate operational applicability as contexts are too various and wide.

South Africa (SAQA) has embarked on a rationalisation of engineering qualification on the National Qualifications Framework. The traditional qualifications (from the Apprenticeship route) such as Plater Welder, Plater Boilermaker, Boilermaker, etc. were mostly similar in content and intent. In order to arrive at a meaningful and acceptable nomenclature for the qualification, it was decided to use "Fabrication" as a description of the type of activity for this qualification.

This presented a problem when attempting to do a comparison of qualifications, nationally and internationally. The problem is that the understanding of the term "Fabrication" is very broad. Many qualifications and outcomes are available but not many in the context of what we (South African Industry) require. The plastic forming industries, as well as the wood and furniture type

industries also use "fabrication" as their activity description. This made the International Comparability research more complex. An attempt to concentrate on contextually relevant qualifications during the research process was thought to be prudent.

African countries with manufacturing and engineering infrastructure (including SADC countries) were scanned for applicable qualifications or training programs, but no relevant (equivalence) qualifications are offered in any of these countries.

Despite exhaustive information searches for information regarding fabrication qualification in Germany and Korea. It was apparent that a similar problem of specialisation as opposed to generalisation existed.

International comparability, including similar qualification structures and progressions from NQF Level 3 to NQF Level 4 were found in the following countries:

United Kingdom:

It appears that the United Kingdom has a qualification process in place that caters for "post qualification" progress. It is also evident that the qualification is comparable to SAQA's whole qualification design process. No unit standards were available for direct comparison to the SAQA Level 4 Fabrication Qualification.

However, some similarity of the qualifications is evident in the fact that the qualifying learner will gain supervisory competence and values in the field of engineering fabrication. The Qualification Supervisory Management in the Fabrication and Welding Industry is made up of Units of Learning with well described supporting "assessment criteria". It is interesting to note that competence a UNIT is the smallest component that will allow the learner to be recognised by issuing a certificate of achievement.

All National Vocational Qualifications in the United Kingdom are achieved through training and assessment. Assessment is normally through on-the-job observation and questioning. Candidates produce evidence to prove they have the competence to meet the NVQ standards. Assessors 'sign-off' units when the candidates are ready - the assessor tests candidates' underpinning knowledge, understanding and work-based performance to make sure they can demonstrate competence in the workplace. This process is fully compatible and comparable with the South African process.

Many of the units of learning are not applicable as they are largely outside the peculiar specialisation areas as required in South Africa. It is not evident what the credit value for this qualification is, as the value of 360 hours as calculated does not equate to a full diploma or qualification in South African terms.

The relevant qualification is shown below:

Diploma for Supervisory Management in Fabrication and Welding Studies NQF Level 4.

Unit Design:

Each unit contains:

- Learning Outcomes: defines what the candidate needs to do.
- Knowledge Requirements: defines what the candidate needs to know. The minimum requirements are outlined.

On completion of this qualification the candidate will be able to demonstrate an understanding of:

- The application of both metallic and non-metallic materials within the fabrication engineering industry.
- Effective supervisory management skills in relation to team working and delegation.
- Fabrication processes and associated site and workshop procedures.
- Operating principles and applications for welding processes.
- Quality management systems.
- The production of working sketches, templates and patterns (both the use of micro computers and by hand) for use in the structural and fabrication industry.
- Applying skills and knowledge gained within industry-relevant context.
- Current industry practice at the supervisory management level.
- Progression routes within the industry.

Qualification Structure:

For successful completion of the ABC Level 4 Diploma for Supervisory Management in Fabrication and Welding, candidates must complete 4 units, one Mandatory and three units from the Option Units listed below:

Mandatory:
- Unit 1 Supervisory Management in the Fabrication and Welding.
Industry (D/103/5302)*.

Optional:
- Unit 2 Applied Fabrication and Welding Science (H/103/5303)*.
- Unit 3 Advanced Fabrication Processes (K/103/5304)*.
- Unit 4 Principles and Applications of Advanced Welding Process.
- Technologies (M/103/5305)*.
- Unit 5 Managing Quality Assurance in the Fabrication and Welding Industry (T103/5306)*.
- Unit 6 Advanced Pattern Development of Plate Work and Metal Structures (A/103/5307)*.

*Numbers in brackets indicate QCA Unit Numbers.

All units have equal weighting.

Qualification Content:

Unit 1:

- Supervisory management in the fabrication and welding industry.
- (60 Guided Learning Hours).

Unit Summary:

This is a Mandatory Unit. The candidate is required to develop an understanding of methods used by management personnel to communicate information between themselves and their workforce.

This will include for example:
- An introduction to the management styles as outlined by McGregor's Theory X/Y and Ouchie's Theory Z.
- An understanding of Maslow's Hierarchy of Needs relative to the fabrication industry and how these may affect human relations.
- An understanding of the types of authority and how this may be delegated.
- The candidate is also required to develop an understanding of Work Study and how this may be applied within the fabrication workshop.

Learning Outcomes:

1.1 Responsibilities and duties of a supervisor.

Candidates will be expected to be able to:
1. Explain the duties and responsibilities of a supervisor.
2. Compare and contrast an authoritarian style of management and a participative one.

1.2 Human Relations.

Candidates will be expected to be able to:
1. Explain and justify the importance of encouraging good human relations within the primary working group.
2. Identify 2 benefits and 2 disadvantages of formal/informal working groups.
3. Evaluate the consequences of permitting unofficial groups and leaders to influence working morale.
4. Produce a management tree structure for at least 3 levels and describe different ways in which each will interact with the other levels.
5. Analyse how motivational theories may influence relationships within a working group.

1.3 Delegating Authority.

Candidates will be expected to be able to:
1. Explain the term 'Formal Authority' and discuss the benefits of authority having been gained by respect.
2. Explain the meaning of the term delegation and discuss the benefits gained from its effective implementation within a company or organisation.
3. Explain and justify two circumstances where the delegation of authority cannot be given.

1.4 Planning of Work.

Candidates will be expected to be able to:
1. Demonstrate an understanding of process planning by discussing the types of planning methods used for named production methods (See Knowledge Requirements) and justifying how each acts to aid the manufacturing process.
2. State and compare the production methods used in the named production methods.

1.5 Work Study.

Candidates will be expected to be able to:
1. Define Work Study, Method Study, and Work Measurement.
2. Explain how work study techniques can be used in the workplace.
3. Describe the different stages required for Method Study and Work Measurement.
4. Use a variety of process charts with appropriate symbols, explaining the sequence of events within them.

Knowledge Requirements:

1.1 Responsibilities and duties of a supervisor.

Candidates should understand:
- The role of a supervisor and their different responsibilities.
  - Operational (how methods and personnel are chosen for a particular function).
  - Technical (The supervisors influence on technical aspects of the production methods).
  - Personnel (How the supervisor's management style affects relationships with the workforce).

• What is meant by an authoritarian style and participative style of management.

1.2 Human Relations.

Candidates should understand:
• The importance of good human relations within the primary working group.
• The difference between formal and informal working groups.
• The difference between official and unofficial group leaders.
• Management tree structures.
• Motivational theories e.g. McGregor's Theory of X/Y and/or Maslow's Hierarchy of Needs.

1.3 Delegating Authority.

Candidates should understand:
• The terms 'formal authority' and delegation and their benefits.
• Circumstances where delegation cannot be given.

1.4 Planning Work.

Candidates should understand:
• Planning methods used for production of:
○ One off job.
○ Batch production.
○ Flow system.
○ Mass production and the production methods used in each.
• The principles of process planning and how it acts as an aid to the manufacturing process.

1.5 Work Study.

Candidates should understand:
• The terms work study, method study and work measurement.
• The different stages required for method study e.g. Selection of tasks to study, recording facts, examining facts, developing a new method, installing/implementing/maintaining it.
• The different stages required for work measurement e.g. selecting the task to study, recording the facts, analysing them, calculating the basic and standard times for the task, agreeing the method and its related time.
• Operation process charts, flow process charts (single and multiple column), multiple activity charts (man and machine), workplaces charts (left and right hand), simultaneous motion cycle charts (SIMO charts) and the types of symbols used in conjunction with these.

Unit 2:

Applied fabrication and welding science.
• (60 Guided Learning Hours).

Unit Summary:

In this Option Unit, the candidate is required to develop an understanding of both metallic and nonmetallic materials and their applications within the fabrication engineering industry: this includes looking at problems such as corrosion, erosion and degradation of plastics. The use of rectification and inverter technology, along with mathematical calculations and applications provide the candidate with the appropriate knowledge to solve problems in the workshop.

Learning Outcomes:

2.1 Materials (Metallic).

Candidates will be expected to be able to:
1. Compare the chemical, physical and mechanical properties of carbon manganese metal, stainless/heat resisting metals, aluminium/aluminium rich alloys, copper/copper rich alloys, titanium, clad materials and hard surfacing alloys.
2. Explain the use of the Schaeffler Diagram.
3. Give typical applications for the materials stated above.

2.2 Materials (Non-Metallic).

Candidates will be expected to be able to:

• Ceramics and glass:
1. Give examples and state the typical properties of engineering ceramics which are based on oxides, nitrides, carbides, borides or silicides and their applications.
2. Simply describe the reaction Bonding, Sintering and Hot pressing methods used to produce ceramic.

• Thermoplastics:
3. Explain the basic structure of polymers and state the typical properties of Thermoplastics.
4. Explain addition polymerisation and the importance of the Dipole Effect.
5. Describe van der Waals forces and explain how they react when heated.

• Thermosetting Plastics:
6. Simply explain how condensation polymerisation is used to produce thermosetting plastic.
7. State the typical properties of thermosetting plastic materials.

• Rubbers (Natural and Synthetic):
8. Describe the properties of natural rubber and explain how sulphur is used to change them.
9. State the typical applications of natural rubber.
10. Explain why synthetic rubbers are used in preference to natural rubber, give examples of synthetic rubbers and state their applications.

2.3 Chemistry.

Candidates will be expected to be able to:

• Corrosion:
1. Define the coherent and non-coherent types of surface corrosion and describe how surface corrosion of metal occurs.
2. Describe the principles of Electrochemical Corrosion. Explain how zinc provides sacrificial protection against corrosion on metal products.
3. Explain how surface corrosion on aluminium may be detrimental to a welded product if it is not removed either prior or during welding.

• Fluxes:
4. Explain the basic compositions and functions of fluxes used in a variety of welding processes (See Knowledge Requirements).

• Changes of State:
5. Describe how the changes of state in a material affect how the material is formed and welded and state the types of defects that this may cause during welding and forming.

2.4 Electricity.

Half and full wave rectification.

Candidates will be expected to be able to:
1. State the reasons why solid state diodes are used in rectifiers.
2. Explain the principle of a half wave rectification for a single phase power supply.
3. Produce 2 simple circuit diagrams, one to illustrate how the half wave rectifier works and one to illustrate how the full wave rectifier works.
4. List the advantages of a rectifier.

- Inverter Technology:

5. Explain the principles of an inverter welding power source.
6. Identify the main components of an inverter and state their function.
7. List the advantages of using an inverter power source.

2.5 Calculations.

Candidates will be expected to be able to:
1. Calculate the bending allowances required when determining the developed lengths of the circumference of a cylinder and angled bends using mean/neutral line for calculations (bending allowances).
2. Determine the thickness allowance to be used when forming.
3. Using practical examples, use simple transposition of formula to solve problems.
4. Calculate the volume of weld metal required for butts of different joint preparations, fillet and outside corner welds including an allowance to ensure the weld is not less than the required size.
5. Calculate the weights of sheet and plate materials in terms of kilograms per square metre.
6. Using realistic prices, determine economical use of plate/sheet for given components.
7. Use trigonometry to determine the length of a line, value of an angle and chord lengths.

Knowledge Requirements:

2.1 Materials (Metallic).

Candidates should understand:

Carbon Manganese metal:
- The typical compositions, applications and weldability of carbon-manganese metals.
- The main problems associated with the welding of carbon-manganese metals and how to avoid such problems.

Stainless/heat resisting metals:
- The typical compositions and weldability of the following: Ferritic, Martensitic, Austenitic and Duplex.
- The use of the Schaeffler Diagram.
- The main differences between stainless and heat resisting metals.

Aluminium and Aluminium Rich Alloys:
- How to categorise these as cast/wrought and heat-treatable/non-heat treatable.
- The effects of adding the alloy elements Silicon, Magnesium, Manganese and Copper to Aluminium (AlSi, AlMg, AlMn and AlCu).

Copper and Copper Rich Alloys:
- The types of copper available to the engineering industry and their weldability.

• The different types of Copper/Zinc (Brass) alloys and show how each type may be determined using the Copper/Zinc Thermal Equilibrium Diagram.
• The different types of Copper/Tin (Bronze) alloys and show how each type may be determined using the Copper/Tin Thermal Equilibrium Diagram.

Titanium:
• Describe properties of the metal.
• Identify typical applications for the use of the metal.

Clad Materials:
• The types and purpose of clad materials in terms of corrosion resistance, mechanical properties and economics.
• How dilution is kept to a minimum during welding.
• How dilution may affect the properties of clad materials.
• The extent of weld metal dilution.

Hard surfacing Alloys:
• The purpose of hard surfacing.
• The types of hard surfacing materials available and why different types are necessary.

2.2 Materials (Non-Metallic).

Candidates should understand:

Ceramics and Glass:
• The term ceramics.
• The typical properties of engineering ceramics based on oxides, nitrides, carbides, borides or silicides and their applications.
• Reaction Bonding, Sintering and Hot Pressing methods used to produce ceramics.

Thermoplastics:
• The basic structure of polymers.
• Addition polymerisation and the importance of the Dipole Effect.
• Van der Waals forces and how they react when heated.

Thermosetting Plastics:
• How condensation polymerisation is used to produce Thermosetting plastic and how the long chain of molecules are bonded by cross linking.
• The properties of thermosetting plastics.

Rubbers (Natural and Synthetic):
• The properties and typical applications of natural rubber and how sulphur is used to change these properties.
• Why synthetic rubbers are used in preference to natural rubbers giving examples and their typical properties.

2.3 Chemistry.

Candidates should understand:

Corrosion:
• Coherent and non-coherent types of corrosion.
• How surface corrosion occurs.
• The principles of Electro-chemical corrosion.
• How zinc provides sacrificial protection against corrosion on metal products.

- The detrimental effect of surface corrosion on aluminium to a welded product.

Erosion:
- The use of hard surfacing to minimise erosion.

Degradation of Plastics:
- The use of additives to ensure temperature stability and prevent colour degradation in plastics.

Fluxes:
- The compositions and functions of fluxes used in oxy-acetylene welding and brazing, manual metal arc welding and submerged arc welding.

Changes of State:
- How changes of state in a material affect how the material is formed and welded.
- The defects the changes of state in materials may cause during forming and welding.

2.4 Electricity.

Half wave and Full Wave Rectification:
- The use of solid state diodes in rectifiers.
- The principle of a half wave rectification for single-phase power supply.
- How the half wave and the full wave rectifier works.
- The advantages of rectifiers.

Inverter Technology:
- The principles of an inverter welding power source.
- The main components of an inverter and their functions.
- The advantages of using an inverter power source.

2.5 Calculations.

- How to calculate bending allowances.
- How to determine thickness allowance when forming.
- Symbolic expression.
- How to use simple transposition of formula to solve problems, using practical examples.
- How to calculate the volume of weld metal required.
- How to calculate weights of sheet and plate materials.
- How to determine economical use of plate/sheet for components.
- The trigonometrical ratios of sine, cosine and tangent relative to the right-angled triangle and how to use them to determine the length of a line, value of an angle and chord lengths.

Unit 3:

Advanced fabrication processes.
- (60 Guided Learning Hours).

Unit Summary:

The candidate is required to provide evidence of competence and an understanding of advanced fabrication processes. The candidate will learn about site and workshop procedures that need to be followed whilst planning, cutting, forming and assembling a range of fabricated components using advanced processes.

Learning Outcomes:

3.1 Layout and Plan Work.

Candidates will be expected to:
1. Explain the suitability of the listed production methods used to produce sheet/plate fabrications and structures (See Knowledge Requirements).
2. Compare marking out methods and state the advantages of using Direct Marking, Templates and Calculations.
3. Describe handling methods and equipment used when handling Sheet, Plate, Non-Ferrous, Plastics and section.
4. Describe the planned disposition of joints on sheet/plate, stating processes and equipment used.

3.2 Procedures for Working on Site.

Candidates will be expected to:
1. State the relevant sections of the Health and Safety at Work etc. Act 1974 and relevant codes of practice.
2. Describe factors to be considered when assembling fabrications on site.
3. Describe the use of Erection Equipment, and Cranes on site.

3.3 Methods of Cutting Sheet, Plate, Non-ferrous, Sections, Plastics and Clad Materials.

Candidates will be expected to:
1. Describe the working principles of non-thermal cutting processes used to cut the stated materials and compare advantages and limitations of the processes.
2. Describe the working principles of thermal cutting processes and compare advantages and limitations of the processes.
3. Compare the relative merits of oxy-fuel gas, plasma, laser and abrasive water jet cutting methods.
4. Describe the application of CNC guillotines for cutting materials.

3.4 Methods of forming Sheet, Plate, Non-ferrous, Sections, Plastics and Clad materials.

Candidates will be expected to:
1. Describe the working principles of different forming machines used to form materials.
2. Compare the use of hand and machine forming capacities taking into account materials' tensile strength, thickness and length of the material, accuracy achieved, speed of operation, Quality required, Limitations and suitability of process.
3. Compare the merits of machine selection for single or batch production of components.
4. Explain the effect of changing the die width on the load required for press brake forming and the required quality of the fabrication.
5. Describe the process of forming, folding, flanging and pressing to inside and outside dimensions, and the necessary allowances required on the developed length.
6. Compare rolling with folding, flanging and pressing of materials and state the need for presetting prior to rolling. State the methods used to pre-set materials and the variation in spring back allowances necessary when forming different materials.

3.5 Methods of assembling Sheet, Plate, Non-ferrous, Sections, Plastics and Clad materials.

Candidates will be expected to:
1. Describe the sequence of assembly required and methods used to control distortion and achieve alignment with dimensional accuracy of fabricated components.
2. Describe the use of jigs, positioner's assembly and erection equipment.

Knowledge Requirements:

3.1 Layout and Plan Work.

Candidates should understand:
• Production methods and scale to include:
○ Batch - Flow - Job - Mass.
• The following marking methods:
○ Direct - Templates - Calculations.
• Handling methods and equipment used for sheet/plate/non-ferrous/plastics and section, to include: manual methods, protection of surfaces, clamps, Crosby clips, suction pad.
• The following processes and equipment related to the planned disposition of joints on Sheet/Plate:
○ Economy of Material.
○ Labour.
○ Simplicity of Fabrication.
○ Joint Location.
○ Distortion Control.
○ Use and Disposition of Templates.
○ Folding/Cutting Allowances.

3.2 Procedures for Working On Site.

Candidates should understand:
• The relevant sections of the Health and Safety at Work etc. Act 1974 and relevant codes of practice to include:
○ Risk Assessments, COSHH, PUWER, Work Permits, site related health and safety regulations, legislation and safe working practices.
• Issues relating to assembly fabrication on site to include:
○ Type and size of fabrication.
○ Size of lifting equipment.
○ Maximum lift - Ground conditions.
○ Site restrictions.
○ Juxtaposition of general public and site.
• The use of erection equipment and cranes:
○ Derricks.
○ Mobile.
○ Tower and Goliath cranes.
○ Use of equipment for specific site conditions.

3.3 Methods of cutting sheet, plate, non-ferrous, sections, plastics and clad materials.

Candidates should understand:
• The working principles of Non-Thermal Cutting Processes to include:
○ Hand and power shears, guillotines, nibblers, turret and power punches, edge cutters, universal plate worker, croppers, punches, power saws, planing, milling, radial arm drills, water jet cutting.
• The working principles of Thermal Cutting Processes to include:
○ Oxy-fuel Gas.
○ Plasma.
○ Laser.
• The relative merits of Oxy-fuel Gas, Plasma, Laser and Abrasive Water Jet Cutting methods in terms of:
○ Equipment Costs.
○ Operating costs.
○ Cutting speed.
○ Kerf width.

- Skill requirements.
- Material type and thickness.
- Process versatility.
- Cut quality.

• The application of CNC guillotines for cutting materials considering:
- Health and safety requirements.
- Blade design.
- Programming operations for blade clearance.
- Back gauge and blade rake angle.
- Ancillaries to aid production.
- Stroke counter.
- Magnetic/non magnetic sheet supports.
- Holding down equipment for soft and polished materials.
- Scrap.
- Dividers and stacker units.

3.4 Describe methods of forming Sheet, Plate, Non-ferrous, Sections, Plastics and Clad Materials.

Candidates should understand:
• The working principles of the following machines forming machines:
- Hand and powered folders.
- CNC Press brake.
- Vertical stroke press.
- Manual and powered rolls.
- Wheeling machine.
- Spinning machine.
- Edging/Flanging machine.
- Rubber pad.
- Hydrostatic.
- Matched die.
- hot wire methods to form plastics.

• Hand and machine forming capacities taking into account:
- Materials Tensile Strength.
- Thickness and length of the material.
- Accuracy achieved.
- Speed of operation.
- Quality required.
- Limitations and suitability of process.

• The benefits of machine selection for single/batch production of components.
• Characteristics of the die width on the load required for press brake forming and the required quality of the fabrication.
• The process of forming, folding, flanging and pressing to inside and outside dimensions, and the necessary allowances required on the developed length.
• Rolling, folding, flanging and pressing of materials and state the need for pre-setting prior to rolling. The methods used to pre-set materials and the variation in spring back allowances necessary when forming different materials.

3.5 Methods of assembling Sheet, Plate, Non-ferrous, Sections, Plastics and Clad materials.

Candidates should understand:
• The sequence of assembly.
• Methods to control distortion and achieve accurate alignment with dimensional accuracy of fabricated components.
• The use of jigs, positioner's assembly and erection equipment in terms of:

- Positioning of components.
- Use of datum's.
- Joint alignment.
- Maintaining shape.
- Sub-assemblies.
- Trial erections.
- Choice of lifting equipment.
- Mass production/repetitive work.
- Manipulation of components.
- Surface protection.
- Economy of operation.

Unit 4:

Principles and applications of advanced welding process technologies.
- (60 Guided Learning Hours).

Unit Summary:

The candidate is required to develop an understanding of the operating principles and applications for advanced welding processes. The advantages and disadvantages of each process are evaluated and this assists in providing the candidate with the necessary skills to select the appropriate process for particular applications. The candidate will also be able to explain the consumable types, fluxes (if any) and flux cored/metal cored wires (where applicable) for successfully welding a variety of materials for these processes.

Learning Outcomes:

4.1 Health and Safety Issues.

Candidates will be expected to:
1. Explain general Health and Safety issues relating to a range of welding processes.

4.2 Inspection Requirements.

Candidates will be expected to:
1. Describe in detail a minimum of 3 inspection requirements relating to a range of welding processes.

4.3 Operating Principles and Applications.

Candidates will be expected to:
1. Describe in detail a range of operating principles and applications on a variety of materials (where appropriate).
2. Identify 2 advantages and 2 disadvantages for each of the processes.

4.4 Different Edge Preparations for Different Materials/Thickness and Processes.

Candidates will be expected to:
1. Describe in detail the required edge preparations for different material types and thickness for the processes listed in knowledge requirements 4.3 and 4.1.

Knowledge Requirements:

4.1 Health and Safety Issues.

Candidates should understand:
• Health and Safety issues specific to the following processes on a variety of materials identified in Knowledge Requirement 4.3.
• Submerged-Arc, Resistance, to include Spot, Seam, Projection Resistance, Butt and Flash Butt welding, MAGS, TAGS, SAW, Plasma, Electron-Beam, Orbital, Robotics, Plastics, Rubbers, Ceramics.
• Pressure-welding to include Cold pressure and Ultra-sonic welding, Pulsed, Carbon-arc, Atomic - hydrogen.
• Stud-welding to include "arc" Capacitor discharge, Laser, Friction, Friction Stir and Explosive.

4.2 Inspection Requirements.

Candidates should understand:
• Inspection requirements for the above processes on a variety of materials identified in Knowledge requirement 4.3.

4.3 Operating Principles and Applications.

Candidates should understand:
• Operating principles and applications of the above processes on a variety of materials listed below for the processes listed in 4.1.
• Materials to include: Carbon and Carbon Manganese Metals, Aluminium, Aluminium Alloys, Ferritic, Martensitic, Austenitic and Duplex Stainless and Heat Resisting. Metals, Copper and Copper Alloys, Magnesium and Magnesium Alloys, Clad Materials, Dissimilar Metals, Hard Surfacing Alloys, Titanium and Titanium Alloys, Plastics, Rubbers, Ceramics.
• Advantages and disadvantages of the processes listed in 4.1.

Unit 5:

Managing quality assurance in the fabrication and welding industry.
• (60 Guided Learning Hours).

Unit Summary:

The Quality Assurance unit is designed to develop the candidate's understanding of Quality Management systems and the specific recommendations set out in European Standards for welding of metallic materials necessary in the fabrication industry.

This unit develops a candidate's understanding of how quality management systems provide the means for an organisation to demonstrate its ability to consistently provide a product that meets customer and applicable regulatory requirements. In addition it also addresses how European standards provide the relevant guidelines for satisfactory production and control of welded fabrications, including some of the possible detrimental phenomena that may occur, with advice on methods by which they may be avoided.

Learning Outcomes:

5.1 Quality Management System.

Candidates will be expected to:
1. Describe the Process-Based Model and the methodology of the PDCA Approach.
2. Identify the general requirements of the Quality Management System.
3. Explain the responsibility of management.
4. Identify how Quality Management Systems influence the product.
5. Explain the importance of measurement, analysis and improvement.

5.2 Quality Requirements for Welding-Fusion Welding of Metallic Materials.

Candidates will be expected to:
1. Outline the manufacturer's contractual requirements and responsibilities regarding Contract Review, Design Review, Sub-contracting.
2. Recognise the manufacturer's need to have at his disposal competent personnel to carry out planning, performing, supervising and examining welding production.
3. Recognise the manufacturer's need to identify and provide the relevant facilities and equipment necessary to produce a quality related to fabrication and welding related activities.
4. Describe welding activities in terms of: Production Plans - Weld procedure approval, Welder approvals, and specifications, Work Instructions and documentation.
5. State the manufacturer's responsibilities regarding:
- Storage of parent materials.
  - Batch testing, storage and handling electrodes.
  - Post weld heat treatment.
6. Explain the manufacturer's responsibilities for inspection and testing before, during and after welding.
7. Describe the measures which should be implemented to deal with non-conformity and corrective actions, calibration, identification and traceability, quality records.

Knowledge Requirements:

5.1 Quality Management System.

Candidates should understand:
- That a Quality Management System can be used by internal and external parties, including certificating bodies, to assess the organisation's ability to meet customer, regulatory and the organisation's own requirements.
- Quality Assurance models to include the Process-Based model and the PDCA Approach (Plan, Do, Check, Act).
- The general requirements of the Quality Management System in terms of:
  - Quality policy.
  - Quality manuals.
  - Control of documents.
  - Control of records.
- Management responsibility in terms of:
  - Management commitment.
  - Customer focus.
  - Quality policy.
  - Planning.
  - Responsibility, authority and communications.
  - Management review.
- The necessity for management to provide:
  - Provision of Resources.
  - Relevant Human Resources.
  - Relevant Infrastructure.
  - Working Environment.
- How Quality Management Systems influence the product via:
  - Planning of product realisation.
  - Customer-related processes.
  - Design and development.
  - Purchasing.
  - Production and service provision.
  - Control of monitoring and measuring devices.

- Case histories of welding and fabrication disasters.
- The importance of measurement, analysis and improvement related to:
- Customer satisfaction.
- Control of nonconforming product.
- Analysis of data.
- Improvement.

5.2 Quality Requirements for Welding-Fusion Welding of Metallic Materials.

Candidates should understand:
- How the application of comprehensive quality requirements provide manufacturers with the capability to produce welded constructions fulfilling specified quality.
- A manufacturer's contractual requirements and responsibilities regarding contract review, design review and subcontracting.
- The need to have competent staff to plan, perform, supervise and examine welding production in terms of:
- Welders.
- Welding Co-coordinators (with reference to the National Welding Training Standard).
- Non destructive testing personnel.
- The need to provide relevant facilities and equipment necessary to produce quality fabrication and welding activities in terms of:
- Description and suitability of equipment.
- Production and testing equipment.
- Maintenance of equipment.
- Welding activities in terms of:
- Production Plans.
- Welding procedure approval.
- Specifications.
- Work instructions.
- Documentation.
- Manufacturers responsibilities regarding Storage of parent materials, Batch testing, storage and handling of electrodes, Post weld heat treatment.
- Manufacturers responsibilities for inspection and testing before, during and after welding.
- Measures which should be implemented to deal with:
- Non-conformity and corrective actions.
- Calibration.
- Identification and traceability.
- Quality records.

Unit 6:

Advanced pattern development of plate work and metal structures.
- (60 Guided Learning Hours).

Unit Summary:

The candidate is required to provide evidence of competence in the ability to interpret and construct workshop drawings, to produce working sketches, to develop templates and patterns as would be used in the structural and fabrication industry.

Learning Outcomes.

The candidate will be expected to:
1. Interpret drawings and use methods of construction to develop complex shape and structural details.

2. Determine lines of intersection to enable the development of complex shapes.
3. Determine complex pattern shapes by the parallel line technique.
4. Determine complex pattern shapes by the radial line technique.
5. Determine complex pattern shapes by the triangulation technique.
6. Draw helical chutes, worm feed blades and spiral stairways.
7. Determine by calculation, sketch and dimension complex pattern shapes with the aid of micro computers.

Knowledge Requirements:

The candidate should understand:
• How to construct auxiliary views in double projection to simplify development of right cylindrical off-set branches and rectangular ducts.
• How to determine true lengths and shapes of structural sections for inclined beams, hip rakers, ties, struts, bevel, cleats and dihedral angle.
• How to use the principle of a common central sphere applied to multiple junction pieces involving 'right' cones and cylinders.
• How to use cutting planes applied to:
○ Right cylindrical branches on transformer pieces.
○ Oblique cone to oblique cone.
○ Inclined right cylindrical branches on right cones on and off-centre.
○ Various branch cross-sections on square/rectangular hoppers.
• How to use the parallel line technique to develop pattern shapes for:
○ Swan-necked transition pieces.
○ Rectangle to rectangle in angular plane.
○ Cylindrical branches on to right segmental bends.
○ Modified set-outs to accommodate material thickness.
• How to use the radial line technique to develop pattern shapes for:
○ Right cones in multiple connections of right cones and right cylinders.
○ Breeches and multi-way pieces involving oblique cones.
• How to use the triangulation technique to:
○ Re-position triangles to aid surface contour and avoid kinks in the construction of transformer pieces.
○ Develop patterns of 'kink' sided hoppers.
○ Develop patterns of quadrilateral to round transformers between parallel planes.
○ Develop patterns of square and rectangle to round transformers with openings at right angles and different levels.
• How to construct the elevations pattern shapes of:
○ Worm feed screw blades showing inner and outer spirals.
○ Spiral stairways and stringers.
○ Helical chutes.
• How to use micro computers to determine, sketch and dimension:
○ Square and rectangular kink sided hoppers.
○ Square to round transformers between parallel planes.
○ Helical chutes and blades.
○ Spiral stairway stringers.
○ Frusta of right cones, including major and minor radii, pattern angle and chordal check length.

New Zealand:

The Level 4 Qualification National Certificate in Engineering - Fabrication (Level 4) with Sectoral strands in Heavy Fabrication, Light Fabrication, and Welding was used as comparison. There is some similarity in the content of the qualifications with the New Zealand qualification being more specific in terms of unit standard titles. (It should be noted that the same qualification was used as comparison within the Level 3 Qualification comparison process).

National Certificates in New Zealand are achieved through training and assessment. Assessment is normally through on-the-job observation and other evidence gathering techniques. Candidates provide evidence to prove they have the competence to meet the NZQA standards. Assessors test candidates' underpinning knowledge, understanding and work-based performance to make sure they can demonstrate competence in the workplace.

This process is fully compatible and comparable with the South African process with the exception that New Zealand has some unit standards with the requirement of being performed "under supervision". This is contrary to outcomes based learning and development principles.

The qualification compares well with the one in New Zealand and also appears to satisfy the comparison in terms of a combined (non-specialist) qualification attainment. This is due to the availability of a choice of strands being available to the industry and the learner.

The minimum credit value for this qualification is listed as 269 credits which indicates that it would compare well with the apprenticeship type qualifications.

The competencies listed in this qualification are as below:

http://www.nzqa.govt.nz/nqfdocs/quals/doc/0122.doc

ID; Title; Level; Credits:

- 101; Develop and use keyboarding skills to enter text; Level 1; 3 Credits.
- 2353; Pre-treat work for subsequent metal surface finishing operations; Level 1 ; 5 Credits.
- 2363; Polish ferrous and non-ferrous metal parts to produce a decorative finish; Level 3; 10 Credits.
- 2387; Assemble mechanical components under supervision; Level 2; 2 Credits.
- 2395; Select, use, and care for engineering hand tools; Level1; 4 Credits.
- 2396; Select, use, and maintain portable hand held engineering power tools; Level 2; 4 Credits.
- 2414; Lay out and mark off regular fabrication shapes under supervision; Level 2; 15 Credits.
- 2415; Form and shape fabrication materials under supervision; Level 2; 10 Credits.
- 2416; Assemble and mechanically join plate and sheet under supervision; Level 2; 10 Credits.
- 2417; Mechanically cut fabrication materials under supervision; Level 2; 8 Credits.
- 2418; Lay out and mark off irregular fabrication shapes under supervision; Level 3; 15 Credits.
- 2419; Form and shape, sheet, plate, pipe and structural sections using power machines under supervision; Level 3; 15 Credits.
- 2420; Assemble and mechanically join tube, pipe and sections under supervision; Level 3; 15 Credits.
- 2421; Mechanically cut fabrication materials using powered machinery under supervision; Level 3; 10 Credits.
- 2422; Lay out and mark off complex fabrication shapes; Level 4; 15 Credits.
- 2423; Form and shape fabrication materials; Level 4; 15 Credits.
- 2424; Assemble and mechanically join sheet, plate, tube, pipe and structural sections; Level 4; 20 Credits.
- 2425; Mechanically cut sheet, plate, tube, pipe and structural sections; Level 4; 10 Credits.
- 2430; Draw and interpret engineering sketches under supervision; Level 2; 4 Credits.
- 2431; Draw and interpret engineering drawings under supervision; Level 2; 8 Credits.
- 2432; Construct engineering plane geometric shapes; Level 2; 3 Credits.
- 2433; Create two dimensional engineering drawings using computer aided design system; Level 2; 6 Credits.
- 2434; Produce detailed engineering drawings under supervision; Level 3; 15 Credits.
- 2438; Produce fabrication drawings; Level 4; 20 Credits.
- 2670; Avoid welding hazards with safe work practices; Level 2; 1 Credit.

- 2671; Weld metal structures with the manual metal arc welding process in down hand positions; Level 3; 6 Credits.
- 2672; Weld metal to a general purpose industry standard with the gas metal arc welding process; Level 3; 6 Credits.
- 2673; Weld metal structures with the gas metal arc welding process in down hand positions; Level 3; 6 Credits.
- 2674; Weld stainless metal plate with the gas metal arc welding processes in the down hand positions; Level 3; 6 Credits.
- 2675; Weld aluminium with the gas metal arc welding process in the down hand positions; Level 3; 6 Credits.
- 2676; Weld stainless metal sheet with the gas tungsten arc welding process; Level 3; 6 Credits.
- 2677; Weld aluminium with the gas tungsten arc welding process in the down hand positions; Level 3; 6 Credits.
- 2678; Join metals with the oxyacetylene welding process; Level 3; 6 Credits.
- 2679; Join metals using torch brazing and soldering; Level 3; 6 Credits.
- 2680; Join metals with the resistance welding process; Level 3; 4 Credits.
- 2681; Weld metal structures with the submerged arc welding process; Level 3; 4 Credits.
- 2682; Weld metal to a general purpose industry standard with the manual metal arc welding process; Level 3; 6 Credits.
- 2683; Cut metals using manual thermal processes; Level 3; 4 Credits.
- 2684; Weld metal structures with the gas metal arc welding processes in all positions; Level 4; 10 Credits.
- 2685; Weld metal structures with the manual metal arc welding process in all positions; Level 4; 10 Credits.
- 2686; Weld aluminium with the gas metal arc welding process in all positions; Level 4; 10 Credits.
- 2687; Weld stainless metal sheet and plate with the gas metal arc welding processes in all positions; Level 4; 10 Credits.
- 2688; Weld stainless metal tube with the gas tungsten arc welding process; Level 4; 10 Credits.
- 2689; Weld aluminium with the gas tungsten arc welding process in all positions; Level 4; 10 Credits.
- 2690; Weld metal pipe with the oxyacetylene process; Level 4; 10 Credits.
- 2691; Cut metals using mechanised thermal processes; Level 4; 4 Credits.
- 2692; Repair non-ferrous metal components by welding; Level 4; 10 Credits.
- 2693; Repair ferrous metal components by welding; Level 4; 10 Credits.
- 2694; Weld metal pipe with the manual metal arc welding process using cellulosic electrodes; Level 4; 20 Credits.
- 2695; Weld metal pipe with the manual metal arc welding process using hydrogen controlled electrodes; Level 4; 20 Credits.
- 2696; Weld pipe in all positions with the gas tungsten arc welding process; Level 4; 12 Credits.
- 2697; Weld aluminium pipe in all positions with the gas tungsten arc welding process; Level 4; 10 Credits.
- 2824; Follow safe working practices on an engineering worksite; Level 2; 3 Credits.
- 3234; Install metal pipe work according to plans and specifications under supervision; Level 3; 12 Credits.
- 3236; Install stainless metal pipe work according to plans and specification under supervision; Level 3; 12 Credits.
- 3238; Manufacture duct work to plans and specifications; Level 3; 20 Credits.
- 4432; Identify and convert basic units of measure used in engineering; Level 1; 1 Credit.
- 4433; Measure with non-complex devices used in engineering; Level 1; 2 Credits.
- 4436; Select, use and care for engineering marking-out equipment; Level 2; 4 Credits.
- 4795; Distinguish the characteristics of engineering materials; Level 1; 2 Credits.
- 4796; Distinguish the characteristics of engineering metals; Level 2; 3 Credits.

- 9184; Erect non-notifiable prefabricated scaffolding; Level 3; 3 Credits.
- 12299; Shift loads in the performance of machinery and equipment installation and maintenance; Level 2; 3 Credits.
- 16954; Calculate lengths, areas and mass of engineering fabrication materials; Level 2; 4 Credits.
- 16955; Calculate sizes, mass, volumes, and quantities for engineering fabrication; Level 3; 4 Credits.
- 16956; Demonstrate knowledge of force and stress in engineering fabrications; Level 4; 4 Credits.
- 18106; Gouge metals using manual thermal processes; Level 3; 2 Credits.
- 18107; Lay out and mark off complex heavy fabrication shapes; Level 4; 15 Credits.

Australia:

Following the Australian Prime Minister's announcement, the responsibilities and functions of the Australian National Training Authority (ANTA) have been transferred to the Department of Education, Science and Training (DEST).

Certificates in Australia are achieved through training and assessment. Assessment is through training provider and on-the-job observation and other evidence gathering techniques. Candidates provide evidence to prove they have the competence to meet the DEST standards. Assessors test candidates' underpinning knowledge, understanding and work-based performance confirm they can demonstrate competence in the workplace. This process is fully compatible and comparable with the South African process.

The trade of Boiler-making is utilised in Australia. However, the process of achieving the qualification is from various options. These options have various specialisations with a set of core components. The list of unit standards shown below are those that make up the entire qualification requirements.

The main areas of learning within this qualification are:
- Heavy Fabrication.
- Light Fabrication.
- Welding.

Other (for comparison purposes) specialisation areas are listed as:
- Refrigeration and Air-conditioning.
- Casting and Moulding.
- CNC programming.
- Fluid Power.
- Instrumentation.
- Jewellery.
- Lock smith.
- Maintenance.
- Marine Electronics.
- Mechatronics.
- Patternmaking.
- Robotics.
- Surface Finishing.
- Tool making.
- Watch making.

This comparison indicates that there are synergies between this SAQA qualification and the qualification listed in Australia (MEM40150).

The competencies listed in the qualification are as follows:

Compulsory Units:

Unit code; Unit title:

- MEM12.23A; Perform engineering measurements.
- MEM12.24A; Perform computations.
- MEM13.14A; Apply principles of occupational health and safety in the work environment.
- MEM14.4A; Plan to undertake a routine task.
- MEM14.5A; Plan a complete activity.
- MEM15.24A; Apply quality procedures.
- MEM15.2A; Apply quality systems.
- MEM16.6A; Organise and communicate information.
- MEM16.7A; Work with others in a manufacturing, engineering or related environment.
- MEM16.8A; Interact with computing technology.
- MEM17.3A; Assist in the provision of on the job training.

Optional (Elective) Units:

Unit code; Unit title; Points:

- MEM5.24B; Perform welding supervision; 12.
- MEM5.25C; Perform welding/fabrication inspection ; 12.
- MEM5.26B; Apply welding principles; 4.
- MEM5.42B; Perform welds to code standards using flux core arc welding process; 6.
- MEM5.43B; Perform welds to code standards using gas metal arc welding process; 6.
- MEM5.44B; Perform welds to code standards using gas tungsten arc welding process; 6.
- MEM5.45B; Perform pipe welds to code standards using manual metal arc welding process; 6.
- MEM5.46B; Perform welds to code standards using manual metal arc welding process; 6.
- MEM5.53A; Set and edit computer controlled thermal cutting machines; 4.
- MEM5.54A; Write basic NC/CNC programs for thermal cutting machines; 4.
- MEM7.16C; Set and edit computer controlled machines/processes; 4.
- MEM7.18C; Write basic NC/CNC programs; 4.
- MEM7.19C;Program NC/CNC machining centre; 2.
- MEM7.20C; Program multiple spindle and/or multiple axis NC/CNC machining centre; 2.
- MEM7.22C; Program CNC wire cut machines; 2.
- MEM7.23C; Program and set up CNC manufacturing cell; 6.
- MEM7.39A; Write programs for industrial robots; 4.
- MEM9.4B; Perform electrical/electronic detail drafting; 8.
- MEM9.6B; Perform advanced engineering detail drafting; 4.
- MEM9.7B; Perform advanced mechanical detail drafting; 4.
- MEM9.8B; Perform advanced structural detail drafting; 4.
- MEM9.9C; Create 2D drawings using computer aided design system; 8.
- MEM9.10C; Create 3D models using computer aided design system; 4.
- MEM9.23A; Create 3D code files using computer aided manufacturing system; 6.
- MEM10.7C; Modify control systems; 6.
- MEM10.8B; Undertake commissioning procedures for plant and/or equipment; 4.
- MEM12.3B; Perform precision mechanical measurement; 2.
- MEM12.4B; Perform precision electrical/electronic measurement; 4.
- MEM12.5B; Calibrate measuring equipment; 6.
- MEM12.25A; Use graphical techniques and perform simple statistical computations; 2.
- MEM14.1B; Schedule material deliveries; 8.
- MEM14.2B; Undertake basic process planning; 8.
- MEM14.3B; Undertake basic production scheduling; 8.
- MEM15.7B; Conduct product and/or process capability studies; 6.

- MEM15.8B; Perform advanced statistical quality control; 2.
- MEM15.10B; Perform laboratory procedures; 8.
- MEM15.11B; Exercise external quality assurance; 6.
- MEM15.12B; Maintain/supervise application of quality procedures; 4.
- MEM15.15B; Examine trading practices; 5.
- MEM15.16B; Inspect pre-packed articles; 8.
- MEM15.17B; Use and maintain reference standards; 3.
- MEM15.18B; Investigate consumer complaints; 6.
- MEM15.19B; Conduct a field inspection; 12.
- MEM15.20C; Perform verification/certification or in-service inspection; 12.
- MEM15.21C; Conduct audits of servicing licensees and public weighbridge licensees; 4.
- MEM15.22B; Verify reference standards; 8.
- MEM16.1B; Give formal presentations and take part in meetings; 2.
- MEM16.3B; Provide advanced customer service; 2.
- MEM16.9A; Research and analyse engineering information; 2.
- MEM16.10A; Write reports; 2.
- MEM16.11A; Communicate with individuals and small groups; 2.
- MEM16.12A; Interpret technical specifications and manuals; 4.
- MEM16.13A; Operate in a self -directed team; 2.
- MEM16.14A; Report technical information; 2.
- MEM17.1B; Assist in development and deliver training in the workplace; 2.
- MEM17.2B; Conduct workplace assessment; 2.
- MEM18.10C; Perform equipment condition monitoring and recording; 4.
- MEM18.11C; Shut down and isolate machines/equipment; 2.
- MEM18.16B; Analyse plant and equipment condition monitoring results; 4.
- MEM18.17C; Modify mechanical systems and equipment; 8.
- MEM18.19B; Maintain pneumatic systems; 4.
- MEM18.21B; Maintain hydraulic systems; 4.
- MEM18.22B; Maintain fluid power controls; 8.
- MEM18.23B; Modify fluid power system operation; 8.
- MEM18.49B; Disconnect/reconnect fixed wired equipment up to 1000 volts a.c./1500 volts d.c.; 3.
- MEM18.50B; Disconnect/reconnect fixed wired equipment over 1000 volts a.c./l 500 volts d.c.; 3.
- MEM18.51B; Fault find and repair/rectify complex electrical circuits; 6.
- MEM18.53B; Modify fluid power control systems; 6.
- MEM18.54B; Fault find, test and calibrate instrumentation systems and equipment; 8.
- MEM18.56B; Diagnose and repair analog equipment and components; 10.
- MEM18.58C; Modify electronic equipment; 4.
- MEM18.59B; Modify electronic systems; 4.
- MEM18.60B; Maintain, repair control instrumentation - single and multiple loop control systems; 8.
- MEM18.61B; Maintain/calibrate complex control systems; 8.
- MEM18.62B; Install, maintain and calibrate instrumentation sensors, transmitters and final control elements; 8.
- MEM18.65B; Diagnose and repair digital equipment and components; 10.
- MEM18.66B; Diagnose and repair microprocessor-based equipment; 6.
- MEM18.67B; Tune control loops - multi controller or multi element systems; 6.
- MEM18.69B; Maintain, repair instrumentation process control analysers; 6.
- MEM18.70C; Modify complex electrical circuits and systems; 6.
- MEM18.73A; Perform advanced equipment testing and diagnostics on mobile plant and equipment; 8.
- MEM18.91B; Maintain and repair multi stage, cascade and/or ultra-cold industrial refrigeration systems; 4.

• MEM18.92B; Maintain and repair commercial and/or industrial refrigeration and/or air conditioning controls; 6.
• MEM18.93B; Maintain and repair integrated industrial refrigeration and/or large air handling system controls; 8.
• MEM19.8B; Prepare jewellery designs; 6.
• MEM19.13B; Produce jewellery metal masters; 4.
• MEM19.18B; Repair jewellery items; 6.
• MEM19.22B; Perform precision micro-mechanism diagnosis and servicing; 6.
• MEM20.8A; Develop and implement a master key system; 4.
• MEM20.11A; Service and repair fire and security containers; 6.
• MEM20.12A; Service and repair mechanical automotive locking systems; 6.
• MEM20.13A; Service automotive transponder sy stems; 2.
• MEM24.2B; Perform penetrant testing; 4.
• MEM24.4B; Perform magnetic particle testing; 4.
• MEM24.6B; Perform eddy current testing; 6.
• MEM24.8B; Perform ultrasonic testing; 6.
• MEM24.10B; Perform radiographic testing; 6.
• MEM24.11B; Establish non-destructive tests; 12.
• MEM24.12B; Apply metallurgy principles; 4.
• MEM25.8B; Repair marine vessel surfaces and structures; 4.
• MEM25.13B; Produce three-dimensional plugs/moulds; 12.
• MEM30.12A; Use mathematical techniques and perform simple statistical computations; 4.
• MEM3.1B; Perform manual production assembly; 4.
• MEM3.2B; Perform precision assembly; 4.
• MEM3.3B; Perform sheet and plate assembly; 4.
• MEM3.4B; Perform electronic/electrical assembly (production); 8.
• MEM3.5B; Rework and repair (electrical/electronic production); 8.
• MEM3.6B; Set assembly stations; 2.
• MEM4.1B; Operate melting furnaces; 4.
• MEM4.2B; Perform gravity die casting; 2.
• MEM4.3B; Operate pressure die casting machine; 4.
• MEM4.4B; Prepare and mix sand for metal moulding; 4.
• MEM4.5B; Produce moulds and cores by hand (jobbing); 16.
• MEM4.6B; Operate sand moulding and core making machines; 8.
• MEM4.7B; Pour molten metal; 4.
• MEM4.8B; Fettle and trim metal castings/forgings; 4.
• MEM4.10B; Develop and manufacture wood patterns; 20.
• MEM4.11B; Produce polymer patterns; 8.
• MEM4.12B; Assemble plated patterns; 8.
• MEM4.13B; Develop and manufacture polystyrene patterns; 2.
• MEM4.14B; Develop and manufacture production patterns; 8.
• MEM4.15B; Develop and manufacture vacuum forming moulds and associated equipment; 6.
• MEM4.16C; Develop and manufacture precision models; 6.
• MEM4.17B; Develop and manufacture gear, conveyor screw and propeller patterns; 4.
• MEM4.18B; Perform general wood working machine operations; 4.
• MEM4.19B; Perform refractory installation and repair; 4.
• MEMS. IB; Perform manual soldering/de-soldering - electrical/electronic components; 4.
• MEM5.2Bl; Perform high reliability soldering and de-soldering; 4.
• MEM5.3B; Perform soft soldering; 2.
• MEM5.4C; Perform routine Oxy-acetylene welding; 2.
• MEM5.5B; Carry out mechanical cutting; 2.
• MEM5.6B; Perform brazing and/or silver soldering; 2.
• MEM5.7C; Perform manual heating and thermal cutting; 2.
• MEM5.8C; Perform advanced manual thermal cutting, gouging and shaping; 2.
• MEM5.9C; Perform automated thermal cutting; 2.

- MEM5.10B; Apply fabrication, forming and shaping techniques; 8.
- MEMS.11C; Assemble fabricated components; 8.
- MEM5.12C; Perform routine manual metal arc welding; 2.
- MEM5.13C; Perform manual production welding; 2.
- MEM5.14C; Monitor quality of production welding/fabrications; 2.
- MEM5.15C; Weld using manual metal arc welding process; 4.
- MEM5.16C; Perform advanced welding using manual metal arc welding process; 4.
- MEM5.17C; Weld using gas metal arc welding process; 4.
- MEM5.18C; Perform advanced welding using gas metal arc welding process; 4.
- MEM5.19C; Weld using gas tungsten arc welding process; 4.
- MEM5.20C; Perform advanced welding using gas tungsten arc welding process; 4.
- MEM5.22C; Perform advanced welding using oxy acetylene welding process; 6.
- MEM5.23C; Weld using submerged arc welding process; 4.
- MEM5.36C; Repair/replace/modify fabrications; 4.
- MEM5.37B; Perform geometric development; 6.
- MEM5.38B; Perform advanced geometric development - cylindrical/rectangular; 2.
- MEM5.39B; Perform advanced geometric development - conical; 2.
- MEM5.40B; Perform advanced geometric development - transitions; 4.
- MEM5.41B; Weld using powder flame spraying; 4.
- MEM5.47B; Weld using flux core arc welding process; 4.
- MEM5.48B; Perform advanced welding using flux core arc welding process; 4.
- MEM5.49B; Perform routine gas tungsten arc welding; 2.
- MEM5.50B; Perform routine gas metal arc welding; 2.
- MEM5.51A; Select welding processes; 2.
- MEM5.52A; Apply safe welding practices; 4.
- MEM6.1B; Perform hand forging; 4.
- MEM6.2B; Perform hammer forging; 4.
- MEM6.3C; Carry out heat treatment; 6.
- MEM6.4B; Select heat treatment processes and test finished product; 6.
- MEM6.5B; Perform drop and upset forging; 4.
- MEM6.6C; Repair springs; 4.
- MEM6.7B; Perform basic incidental heat/quenching, tempering and annealing; 2.
- MEM6.8A; Hammer forge complex shapes; 4.
- MEM6.9A; Hand forge complex shapes; 4.
- MEM7.1B; Perform operational maintenance of machines/equipment; 2.
- MEM7.2C; Perform precision shaping/planing/slotting operations; 4.
- MEM7.3B; Perform machine setting (routine); 4.
- MEM7.4B; Perform machine setting (complex); 8.
- MEM7.5B; Perform general machining; 8.
- MEM7.6B; Perform lathe operations; 4.
- MEM7.7B; Perform milling operations; 4.
- MEM7.8C; Perform grinding operations; 4.
- MEM7.9B; Perform precision jig boring operations; 4.
- MEM7.10B; Perform tool and cutter grinding operations; 4.
- MEM7.11B; Perform complex milling operations; 4.
- MEM7.12B; Perform complex grinding operations; 4.
- MEM7.13B; Perform machining operations using horizontal and/or vertical boring machine; 4.
- MEM7.14B; Perform electro-discharge (EDM) machining operations; 4.
- MEM7.15B; Set computer controlled machines/processes; 2.
- MEM7.21B; Perform complex lathe operations; 4.
- MEM7.24B; Operate and monitor machine/process; 4.
- MEM7.25B; Perform advanced machine/process operation; 6.
- MEM7.26B; Perform advanced plastic processing; 6.
- MEM7.27B; Perform advanced press operations; 6.
- MEM7.28B; Operate computer controlled machines/processes; 2.

- MEM7.29B; Perform routine sharpening/maintenance of production tools and cutters; 4.
- MEM7.30C; Perform metal spinning lathe operations (basic); 8.
- MEM7.31C; Perform metal spinning lathe operations (complex); 4.
- MEM7.32B; Use workshop machines for basic operations; 2.
- MEM7.33B; Operate and monitor basic boiler; 6.
- MEM7.34A; Operate and monitor intermediate class boiler; 4.
- MEM7.40A; Set multistage integrated processes; 6.
- MEM8.1B; Perform wire, jig and barrel load/unload work; 4.
- MEM8.2C; Pre-treat work for subsequent surface coating; 4.
- MEM8.3C; Perform electroplating operations; 6.
- MEM8.4B; Finish work using wet, dry and vapour deposition methods; 4.
- MEM8.5B; Prepare and produce specialised coatings; 4.
- MEM8.6B; Produce clear and/or coloured and/or sealed anodised films on aluminium; 2.
- MEM8.7B; Control surface finish production and finished product quality; 4.
- MEM8.8B; Operate and control surface finishing waste treatment process; 3.
- MEM8.9C; Make up solutions; 2.
- MEMS.1OB; Manually finish/polish materials; 6.
- MEM8.11B; Prepare surfaces using solvents and/or mechanical means ; 2.
- MEM8.12B; Prepare surfaces by abrasive blasting (basic); 4.
- MEM8.13B; Prepare surfaces by abrasive blasting (advanced); 4.
- MEM8.14B; Apply protective coatings (basic); 4.
- MEM8.15B; Apply protective coatings (advanced); 4.
- MEM8.16B; Control blast coating by-products, materials and emissions; 1.
- MEM8.18; Electroplate engineering coatings; 6.
- MEM8.19B; Electroplate protective finishes; 6.
- MEM8.20B; Electroplate decorative finishes; 6.
- MEM9.2B; Interpret technical drawing; 4.
- MEM9.3B; Prepare basic engineering drawing; 8.
- MEM9.5B; Perform basic engineering detail drafting; 8.
- MEM9.11B; Apply basic engineering design concepts; 6.
- MEM9.21B; Interpret and produce curved 3-dimensional shapes; 4.
- MEM9.22A; Create 2D code files using computer aided manufacturing system; 4.
- MEM10.1C; Erect structures; 4.
- MEM10.2B; Terminate and connect electrical wiring; 3.
- MEM10.3B; Install and test electrical wiring and circuits up to 1000 volts a.c. and 1500 volts d.c.; 12.
- MEM10.4B; Enter and change programmable controller operational parameters; 2.
- MEM10.5B; Commission programmable controller programs; 4.
- MEM10.6B; Install machine/plant; 4.
- MEM10.9B; Install refrigeration and air conditioning plant and equipment; 4.
- MEM10.10B; Install pipe work and pipe work assemblies; 4.
- MEM10.11B; Terminate and connect specialist cables; 3.
- MEM10.12A; Install split air conditioning system; 4.
- MEM11.1C; Erect/dismantle scaffolding and equipment; 4.
- MEM11.2C; Erect/dismantle complex scaffolding and equipment; 4.
- MEM11.3B; Coordinate erection/dismantling of complex scaffolding/equipment; 4.
- MEM11.4B; Undertake dogging; 4.
- MEM11.5B; Pick and process orders; 4.
- MEM11.6B; Perform production packaging; 2.
- MEM11.7B; Administer inventory procedures; 4.
- MEM11.8B; Package materials (stores and warehouse); 2.
- MEM11.9B; Handle/move bulk fluids/gases; 4.
- MEM11.10B; Operate mobile load shifting equipment; 4.
- MEM11.11B; Undertake manual handling; 2.
- MEM11.12B; Purchase materials; 6.

- MEM11.13B; Undertake warehouse receivable process; 4.
- MEM11.14B; Undertake warehouse dispatch process; 4.
- MEM11.15B; Manage warehouse inventory system; 6.
- MEM11.16B; Order materials; 2.
- MEM11.17B; Organise and lead stock takes; 4.
- MEM11.18B; Organise and maintain warehouse stock receivable and/or dispatch system; 6.
- MEM11.19B; Undertake tool store procedures; 4.
- MEM11.20B; Perform advanced warehouse computer operations; 4.
- MEM11.21B; Perform advanced operation of load shifting equipment; 2.
- MEM11.22B; Operate fixed/moveable load shifting equipment; 4.
- MEM12.1B; Use comparison and basic measuring devices; 2.
- MEM12.2B; Perform electrical/electronic measurement; 2.
- MEM12.6B; Mark off/out (general engineering); 4.
- MEM12.7C; Mark off/out structural fabrications and shapes; 8.
- MEM12.19B; Measure components using coordinate measuring machine; 4.
- MEM12.20B; Set and operate coordinate measuring machine; 2.
- MEM12.21B; Program coordinate measuring machine; 4.
- MEM12.22B; Program coordinate measuring machine (advanced); 2.
- MEM13.1B; Perform emergency first aid; 2.
- MEM13.2B; Undertake occupational health and safety activities in the workplace; 3.
- MEM13.3B; Work safely with industrial chemicals and materials; 2.
- MEM13.4B; Work safely with molten metals/glass; 2.
- MEM13.6B; Collect and evaluate occupational health and safety data for an enterprise or section of an enterprise; 4.
- MEM13.7B; Maintain water treatment systems for cooling towers; 2.
- MEM13.10A; Supervise occupational health and safety in an industrial work environment; 4.
- MEM13.13B; Work safely with ionizing radiation; 4.
- MEM15.1B; Perform basic statistical quality control; 2.
- MEM15.3B; Use improvement processes in team activities; 4.
- MEM15.4B; Perform inspection; 2.
- MEM15.5B; Select and control inspection processes and procedures; 4.
- MEM16.2C; Conduct formal interviews and negotiations; 4.
- MEM16.4B; Perform internal/external customer service; 2.
- MEM16.5A; Operate as a team member to conduct manufacturing, engineering or related activities; 2.
- MEM18.1C; Use hand tools; 2.
- MEM18.2B; Use power tools/hand held operations; 2.
- MEM18.3C; Use tools for precision work; 4.
- MEM18.4B; Maintain and overhaul mechanical equipment; 4.
- MEM18.5B; Perform fault diagnosis, installation and removal of bearings; 4.
- MEM18.6B; Repair and fit engineering components; 6.
- MEM18.7B; Maintain and repair mechanical drives and mechanical transmission assemblies; 4.
- MEM18.8B; Balance equipment; 2.
- MEM18.9B; Perform leveling and alignment of machines and engineering components; 4.
- MEM18.12B; Perform installation and removal of mechanical seals; 2.
- MEM18.13B; Perform gland packing; 2.
- MEM18.14B; Manufacture press tools and gauges; 8.
- MEM18.15B; Maintain tools and dies; 4.
- MEM18.18C; Maintain pneumatic system components; 4.
- MEM18.20B; Maintain hydraulic system components; 4.
- MEM18.24B; Maintain engine cooling systems; 2.
- MEM18.25B; Service combustion engines; 2.
- MEM18.26C; Test compression ignition fuel systems; 4.
- MEM18.27C; Overhaul engine fuel system components; 8.

- MEM18.28B; Maintain engine lubrication systems; 2.
- MEM18.29B; Tune diesel engine; 4.
- MEM18.30B; Diagnose and rectify low voltage electrical systems; 8.
- MEM18.31B; Diagnose and rectify low voltage starting systems; 2.
- MEM18.32B; Maintain induction/exhaust systems; 4.
- MEM18.33B; Perform engine bottom-end overhaul; 4.
- MEM18.34B; Perform engine top-end overhaul; 8.
- MEM18.35B; Diagnose and rectify braking systems; 6.
- MEM18.37B; Diagnose and rectify low voltage charging systems; 2.
- MEM18.38B; Maintain wheels and tyres; 2.
- MEM18.39B; Diagnose and rectify track type undercarriage; 4.
- MEM18.40B; Maintain suspension systems; 4.
- MEM18.41B; Maintain steering systems; 4.
- MEM18.42C; Diagnose and rectify manual transmissions; 4.
- MEM18.43C; Diagnose and rectify automatic transmissions; 8.
- MEM18.44C; Diagnose and rectify drive line and final drives; 4.
- MEM18.45B; Fault find/repair electrical equipment/components up to 250 volts single phase supply; 4.
- MEM18.46B; Fault find/repair electrical equipment/components up to 1000 volts a.c./1500 volts d.c.; 10.
- MEM18.47B; Diagnose and maintain electronic controlling systems on mobile plant; 4.
- MEM18.48B; Fault find and repair/rectify basic electrical circuits; 12.
- MEM18.52B; Maintain fluid power systems for mobile plant; 4.
- MEM18.55B; Dismantle, replace and assemble engineering component; 3.
- MEM18.57B; Maintain/service analog/digital electronic equipment; 6.
- MEM18.63B; Terminate signal and data cables; 4.
- MEM18.64B; Maintain instrumentation system components; 6.
- MEM18.71B; Connect/disconnect fluid conveying system components; 2.
- MEM18.72B; Manufacture fluid conveying conductor assemblies; 4.
- MEM18.86B; Test, recover, evacuate and charge refrigeration systems; 4.
- MEM18.87B; Service and repair domestic and light commercial refrigeration and air conditioning equipment; 6.
- MEM18.88B; Maintain and repair commercial air conditioning systems and components; 4.
- MEM18.89B; Maintain and repair central air handling systems; 6.
- MEM18.90B; Maintain and repair industrial refrigeration systems and components; 6.
- MEM18.94B; Service and repair commercial refrigeration; 6.
- MEM18.95A; Maintain and repair cooling towers/evaporative condensers and associated equipment; 4.
- MEM18.96A; Maintain, repair/replace and adjust refrigerant flow controls and associated equipment; 6.
- MEM18.97A; Manufacture cavity dies; 8.
- MEM19.1B; Perform jewellery metal casting; 6.
- MEM19.2B; Prepare jewellery illustrations; 4.
- MEM19.3B; Handle gem materials; 2.
- MEM19.4B; Handle and examine gemstone materials; 6.
- MEM19.5B; Produce three-dimensional precision items; 8.
- MEM19.6B; Replace watch batteries; 1.
- MEM19.7B; Perform gemstone setting; 6.
- MEM19.9B; Perform investment procedures for lost wax casting process; 1.
- MEM19.10B; Produce rubber moulds for lost wax casting process; 2.
- MEM19.11B; Perform wax injection of moulds for lost wax casting process; 2.
- MEM19.12B; Produce jewellery wax model; 4.
- MEM19.14B; Perform hand engraving; 4.
- MEM19.15B; Perform jewellery enamelling; 4.
- MEM19.16B; Construct jewellery components; 4.

- MEM19.17B; Fabricate jewellery items; 6.
- MEM19.20B; Fault-find and maintain micro-mechanisms; 4.
- MEM19.21B; Diagnose and service micro-mechanisms; 6.
- MEM20.1A; Produce keys; 4.
- MEM20.2A; Assemble and test lock mechanisms; 6.
- MEM20.3A; Install and upgrade locks and hardware; 4.
- MEM20.4A; Gain entry; 4.
- MEM20.5A; Install and maintain door control devices/systems; 2.
- MEM20.6A; Maintain and service mechanical locking devices; 6.
- MEM20.7A; Plan and prepare a master key system; 6.
- MEM20.9A; Gain entry and reinstate fire and security containers; 4.
- MEM20.10A; Gain entry and reinstate automotive locking systems; 4.
- MEM20.14A; Perform a site security survey; 2.
- MEM24.1B; Perform basic penetrant testing; 2.
- MEM24.3B; Perform basic magnetic particle testing; 2.
- MEM24.5B; Perform basic eddy current testing; 2.
- MEM24.7B; Perform ultrasonic thickness testing; 7.
- MEM24.9B; Perform basic radiographic testing; 2.
- MEM25.1B; Apply fibre-reinforced materials; 2.
- MEM25.2B; Form and integrate fibre-reinforced structures; 4.
- MEM25.3B; Set up marine vessel structures; 4.
- MEM25.4B; Fair and shape surfaces; 2.
- MEM25.5B; Construct and assemble marine vessel timber components; 8.
- MEM25.6B; Undertake marine sheathing operations; 2.
- MEM25.7B; Maintain marine vessel surfaces; 4.
- MEM25.9B; Form timber shapes using hot processes; 2.
- MEM25.10B; Perform fit-out procedures; 4.
- MEM25.11B; Install marine systems; 8.
- MEM25.12B; Install and test operations of marine auxiliary systems; 6.
- MEM25.14B; Perform marine slipping operations; 2.
- MEM25.15A; Assemble and install equipment and accessories/ancillaries; 2.
- MEM50.2B; Work safely on marine craft; 1.
- MEM50.3B; Follow work procedures to maintain the marine environment; 1.
- MEM50.4B; Maintain quality of environment by following marina codes; 1.
- MEM50.9B; Safely operate a mechanically powered recreational boat; 2.
- AUR2801A; Carry out minor panel repairs; 4.
- BSBOHS502;A; Participate in the management of the OHS information and data systems; 2.
- BSBOHS602A; Develop OHS information and data analysis and reporting and recording processes; 2.
- BSBOHS601A; Develop a systematic approach to managing OHS; 4.
- BSBOHS603A; Analyse and evaluate OHS risk; 4.
- ICTTC136B; Install, maintain and modify customer premises communications cabling: ACA Restricted Rule; 6.
- ICTTC137B; Install, maintain and modify customer premises communications cabling: ACA Open Rule; 6.
- MEA405A; Repair/modify aircraft composite material structure/components; 4.
- PMBPROD291A; Operate resin infusion moulding equipment; 2.
- PMBPROD294; Operate resin transfer moulding equipment; 2.
- PMBPROD298A; Operate equipment using pre-pregs material; 2.
- PMBPROD391A; Produce composites using resin infusion; 4.
- PMBPROD394A; Produce composites using resin transfer moulding; 4.
- PMBPROD398A; Produce composites using pre-pregs; 4.
- PRSTS202A; Install security equipment/system; 4.
- PRSTS302A; Program security equipment/system; 2.
- PRSTS303A; Test installed security equipment/system; 2.

- PRSTS304A; Commission/decommission security equipment/system; 2.
- PRSTS305A; Identify and diagnose electronic security equipment/system fault; 2.
- PRSTS307A; Maintain and service security equipment/system; 4.
- PRSTS317A; Provide estimate and quote; 4.
- PRSTS319A; Modify and repair security' equipment/system; 4.

- A direct comparison with these international qualifications indicates that the education and training focus of all the qualifications is basically the same. However, the basic construct differs in that the nomenclature is dissimilar to that used in South Africa.

- This SAQA Qualification compares well with the international qualifications and training programs offered. The specific operational content (elective component) incorporated in the qualification will serve to enable qualifying learners to make better informed decisions within an expansive context that compares well with international learners. The South African Qualification is very explicit in the way elective competencies play a role in contextual competence.

It is not evident what the credit value for this qualification.

***ARTICULATION OPTIONS***

The Qualification has been designed and structured so that qualifying learners may move from one engineering context to certain other engineering contexts (within same industry sector or to new industry sectors). This can be achieved by the selection of appropriate credits in the elective category. Equally, holders of other similar qualifications may be evaluated against this qualification for the purpose of RPL.

Horizontal articulation:

Other contextually relevant engineering qualifications may be:

- ID 57877: Further Education and Training Certificate: Welding Application and Practice at NQF Level 4.
- ID 23275: Further Education and Training Certificate: Mechanical Engineering: Fitting at NQF Level 4.

Vertical articulation:

- Possible further specialisation in the welding and fabrication environments.

***MODERATION OPTIONS***

- Anyone assessing a learner or moderating the assessment of a learner against the qualification must be registered as an assessor with the relevant Education, Training, Quality, Assurance (ETQA) Body, or with an ETQA that has a Memorandum of Understanding with the relevant ETQA.

- Any institution offering learning that will enable the achievement of this qualification must be accredited as a provider with the relevant Education, Training, Quality, Assurance (ETQA) Body, or with an ETQA that has a Memorandum of Understanding with the relevant ETQA.

- Assessment and moderation of assessment will be overseen by the relevant Education, Training, Quality, Assurance (ETQA) Body, or by an ETQA that has a Memorandum of Understanding with the relevant ETQA, according to the ETQA's policies and guidelines for assessment and moderation.

- Moderation must include both internal and external moderation of assessments, unless ETQA policies specify otherwise. Moderation should also encompass achievement of the competence described in the associated unit standards.

• Anyone wishing to be assessed against this qualification may apply to be assessed by any assessment agency, assessor or provider institution that is accredited by the relevant ETQA.

***CRITERIA FOR THE REGISTRATION OF ASSESSORS***
Assessors should be in possession of:

• An appropriate qualification at or above the level of the qualification and preferably relevant workplace practical experience.
• Registration as an assessor with the relevant ETQA.

***NOTES***
N/A

***UNIT STANDARDS***

| | ID | UNIT STANDARD TITLE | LEVEL | CREDITS |
|---|---|---|---|---|
| Core | 116714 | Lead a team, plan, allocate and assess their work | Level 3 | 4 |
| Core | 244341 | Perform heat manipulation processes on plate, pipe and structural materials | Level 3 | 4 |
| Core | 13254 | Contribute to the implementation and maintenance of business processes | Level 4 | 10 |
| Core | 12253 | Cut, drill and punch, assemble and mechanically join structural steel work | Level 4 | 24 |
| Core | 12252 | Develop and fabricate from complex drawings | Level 4 | 28 |
| Elective | 243056 | Weld carbon steel workpieces using the shielded metal arc welding process in all positions | Level 2 | 16 |
| Elective | 243064 | Weld carbon steel workpieces, using the gas metal arc welding process in all positions | Level 2 | 15 |
| Elective | 13275 | Perform heat treatment processes on engineering metals | Level 3 | 8 |
| Elective | 13260 | Perform non-destructive tests on metal parts and components | Level 3 | 6 |
| Elective | 12814 | Remove metals using air-carbon arc gouging processes | Level 3 | 4 |
| Elective | 243052 | Weld carbon steel workpieces using the cored-wire welding process in all positions | Level 3 | 8 |
| Elective | 243058 | Weld carbon steel workpieces using the gas tungsten arc welding process in all positions | Level 3 | 25 |
| Elective | 243068 | Weld carbon steel workpieces using the gas tungsten arc welding process in the downhand position | Level 3 | 15 |
| Elective | 114194 | Demonstrate understanding of regulations codes and drawing office practices for structural steel detailing | Level 4 | 7 |
| Elective | 14473 | Develop and produce computer aided drawings | Level 4 | 4 |
| Elective | 14492 | Identify, interpret and produce working piping drawings | Level 4 | 6 |
| Elective | 243054 | Weld carbon steel pipe, using the gas tungsten arc welding process in all positions | Level 4 | 20 |
| Fundamental | 119472 | Accommodate audience and context needs in oral/signed communication | Level 3 | 5 |
| Fundamental | 119457 | Interpret and use information from texts | Level 3 | 5 |
| Fundamental | 119467 | Use language and communication in occupational learning programmes | Level 3 | 5 |
| Fundamental | 119465 | Write/present/sign texts for a range of communicative contexts | Level 3 | 5 |
| Fundamental | 9015 | Apply knowledge of statistics and probability to critically interrogate and effectively communicate findings on life related problems | Level 4 | 6 |
| Fundamental | 119462 | Engage in sustained oral/signed communication and evaluate spoken/signed texts | Level 4 | 5 |
| Fundamental | 119469 | Read/view, analyse and respond to a variety of texts | Level 4 | 5 |
| Fundamental | 9016 | Represent analyse and calculate shape and motion in 2- and 3-dimensional space in different contexts | Level 4 | 4 |
| Fundamental | 119471 | Use language and communication in occupational learning programmes | Level 4 | 5 |
| Fundamental | 7468 | Use mathematics to investigate and monitor the financial aspects of personal, business, national and international issues | Level 4 | 6 |

| | ID | UNIT STANDARD TITLE | LEVEL | CREDITS |
|---|---|---|---|---|
| Fundamental | 119459 | Write/present/sign for a wide range of contexts | Level 4 | 5 |
| | | | | |

SOUTH AFRICAN QUALIFICATIONS AUTHORITY

***UNIT STANDARD:***

***Perform heat manipulation processes on plate, pipe and structural materials***

| *SAQA US ID* | *UNIT STANDARD TITLE* | | |
|---|---|---|---|
| 244341 | Perform heat manipulation processes on plate, pipe and structural materials | | |
| *ORIGINATOR* | | *PROVIDER* | |
| SGB Generic Manufacturing, Engineering & Technolog | | | |
| *FIELD* | | *SUBFIELD* | |
| 6 - Manufacturing, Engineering and Technology | | Engineering and Related Design | |
| *ABET BAND* | *UNIT STANDARD TYPE* | *NQF LEVEL* | *CREDITS* |
| Undefined | Regular | Level 3 | 4 |

**SPECIFIC OUTCOME** 1
Discuss and explain the effects of heat on plate, pipe and structural steelwork.

**SPECIFIC OUTCOME** 2
Determine heat manipulation requirements.

**SPECIFIC OUTCOME** 3
Prepare materials and equipment for heat manipulation process.

**SPECIFIC OUTCOME** 4
Perform heat manipulation of plate, pipe and structural steelwork.

**SPECIFIC OUTCOME** 5
Care for and store consumables and equipment.